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(71) Applicant *(for all designated States except US)*: RE-LIGHT [DK/DK]; Rosenfeldt 58, DK-3600 Frederikssund (DK).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: PEDERSEN, Troels [DK/DK]; Rosenfeldt 58, DK-3600 Frederikssund (DK).

(74) Agent: PLOUGMANN, VINGTOFT & PARTNERS A/S; Sankt Annæ Plads 11, P.O. Box 3007, DK-1021 Copenhagen K (DK).

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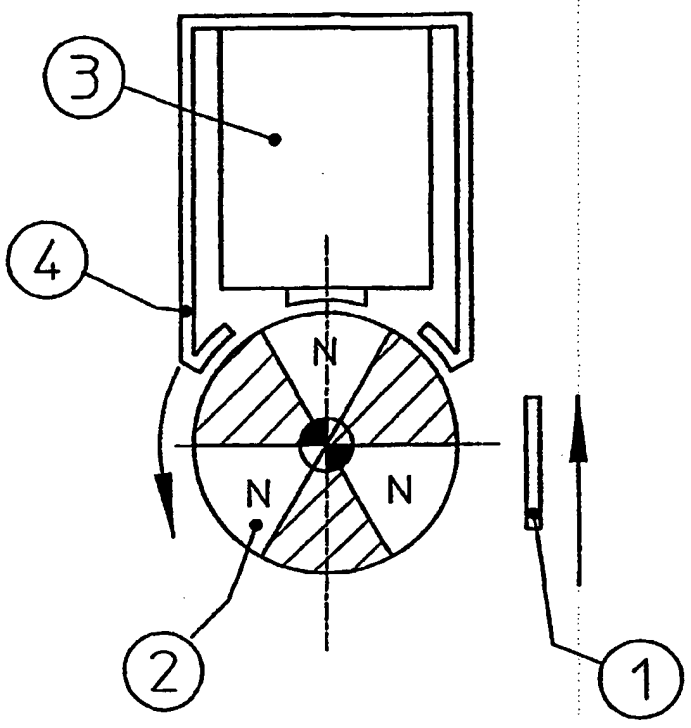
(54) Title: AN ELECTRICITY GENERATING DEVICE FOR A VEHICLE



(57) Abstract: An electricity generating device for a vehicle comprising at least a first and a second part that is moveable in relation to each other. The electricity generating device comprises at least one coil (3) being attached to the first part, and the coil comprises a core (4), layers of windings and a first and a second electrical output to which light emitting means may

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be connected. One or more first magnets (2) are attached to said first part for creating a magnetic flux through the coil, and one or more metallic elements (1) are attached to said second part. Thus, a current may be induced in the coil when the size of the magnetic flux passing through the coil is changed by moving the second part in relation to the first part, or vice versa, so that the metallic elements pass said first magnet(s).

AN ELECTRICITY GENERATING DEVICE FOR A VEHICLE

Technical Field

The present invention relates to an electricity generating device for a vehicle, such as a bicycle, e.g. for illumination of a bicycle. The electricity generating device may be used in combination with lightsignal devices or in combination with electric devices in general on the vehicle.

Background of the invention

Electric generators for vehicles as bicycles are known in various forms.

Some devices are only making flashing signal outputs for warning lights or signalling devices e.g. in such a way that emitting signals are generated every time a magnetic device passes an induction coil connected to a lighting device such as a LED. Such devices are known from US 5,590,946.

Other devices are making a more constant electric output. Some of these devices are known as dynamos driven by the wheel of the bicycle, either by rolling on the tyre of the bicycle or connected directly to the centre of the wheel. These dynamos generally comprise a rotating magnet and a coil around the magnet, so that electricity may be provided as the bicycle moves and the magnet is driven.

Other types of generators or dynamos can be seen in e.g. DE 42 29 261 C1. Here multiples of magnets are arranged on a disc attached to the wheel, and which induce electric energy in a coil connected to the frame of the bicycle.

The known dynamo types, which are driven by letting the rotor abutting the tyre on the bicycle, are very sensitive to the friction provided between the tyre and the rotor. If it is damp weather or it rains then the friction is low and the dynamo does not work properly.

Description of the invention

It is an object of the present invention to provide an electricity generating device for a vehicle, such as a bicycle or any other vehicle comprising two parts movable in relation to

each other, such as a wheel and the fork or the crank and the frame of a bicycle. The device should not be sensitive to the weather conditions and does not require a comprehensive rebuilding of the vehicle for mounting it thereto.

A further object of the present invention is to provide an electricity generating device which is light, simple and cheap to produce yet reliable and which provides a good performance.

According to a first aspect the present invention relates to an electricity generating device for a vehicle comprising at least a first and a second part being moveable in relation to each other, the electricity generating device comprising:

- at least one coil attached to said first part, the coil having a core, layers of windings and a first and a second electrical output,
- one or more first magnets attached to said first part for creating a magnetic flux through the coil,
- one or more metallic elements attached to said second part, and

wherein a current is induced in the coil when the size of the magnetic flux passing through the coil is changed by moving the second part in relation to the first part, or vice versa, so that the metallic elements pass said first magnet(s).

When moving the metallic element past the magnet that is preferably positioned adjacent to the coil, the magnetic flux is changed in the coil as the magnet moves due to the attraction between the metallic elements and the magnet(s). By changing the magnetic flux a current is induced in the coil and thus a potential difference between the first and second output is provided. The first and second electrical outputs could be the two ends of the winding, respectively.

The first magnet(s) may be fixed mounted in relation to the coil or they may be mounted so that the can oscillate and/or rotate in relation to the coil when the metallic elements pass.

In another embodiment, the first magnet(s) may be positioned inside the coil so as to constitute the core of the coil.

The metallic elements provide the changing of the magnetic flux by passing the magnets and their influence on the coil may be different depending on their position and movement in relation to the magnets. In a first embodiment the metallic elements may be adapted to neutralise the influence of the first magnet(s) on the coil by generating a magnetic field, which acts opposite in relation to the magnetic field created by the first magnet(s), due to eddy currents created during magnetisation of the metallic elements. The opposite magnetic field may act directly on the coil or first magnet(s) so as to neutralise the first magnet(s) influence on the coil.

In a second embodiment, the metallic elements may be adapted to increase the magnetisation of the coil when passing by the first magnet(s) and the coil, as the elements decrease the air gap through which the magnetism travels between the first magnet(s) and the coil. The distance between the metallic elements and the first magnet(s) may vary depending on how strong the attraction between the magnet(s) and the elements should be.

In a further embodiment, the metallic elements may be adapted to prevent or at least damp the magnetisation of the coil by passing between the first magnet(s) and the coil for creating a magnetic skin effect. Thus, the first magnet(s)' influence on the coil is reduced, but a current in the coil is still induced as the important thing is to provide a change in the magnetic flux which is obtained by creating said skin effect.

The first magnet(s) may be freely suspended in the coil so that each magnet can rotate around an axis of rotation being substantially perpendicular to the longitudinal axis of the coil.

Of course, the angle between the axis of rotation of the magnet(s) and the longitudinal axis of the coil may be any angle between 0°-90°.

According to a second aspect, the present invention relates to an electricity generating device for a vehicle comprising at least a first and a second part being moveable in relation to each other, the electricity generating device comprising:

- at least one coil attached to said first part and comprising a core, layers of windings and a first and a second electrical output,

- one or more first magnets attached to said first part for creating a magnetic flux through the coil,
- one or more second magnets connected to the first magnet(s) for moving said first magnet(s),
- one or more metallic elements attached to said second part,

wherein a current is induced in the coil when the size of the magnetic flux passing through the coil is changed by moving the second part in relation to the first part, or vice versa, so that the metallic elements pass the second magnet(s).

Thus, the second magnet(s) are moved when passing the metallic elements past them and thereby the first magnet(s) are moved which provide a change in the magnetic flux in the coil, as described above.

Preferably, the metallic elements are made of magnetic conductive material (ferromagnetic material), but they can be made of any metal depending on their purpose (increasing or decreasing the magnetisation of the coil).

The device may comprise mounting means for mounting it to a bicycle or a car. In case it is mounted to a bicycle, the first part may be the front/rear fork of a bicycle and the second part may be the wheel or spokes of the wheel, or vice versa. The device may be mounted on the bicycle, e.g., near the hub on the front or rear wheel.

Preferably, the metallic elements are attached to the spokes of a wheel or rim or centre of a wheel on the vehicle, and the metallic elements may be formed as a ring with different formed cuts and protrusions or formed as a number of small metallic elements, such as discs attached to the spokes. Each time a cut or protrusion passes the first and/or second magnet(s), the magnet(s) are moved.

The spokes of a wheel on the vehicle may constitute the metallic elements, or a combination of both metallic elements attached to the spokes and the spokes themselves may constitute the metallic elements.

Alternatively, the coil may be mounted to the movable part and the magnet(s) to the stationary part.

Depending on the amount of current to be induced, the number of windings in each layer of the coil may be varied. Preferably, the number of windings in each layer exceeds the number of layers of windings, and the ratio between the number of windings in each layer and the number of layers may be 2 or 3 or 4 or 5 or more.

Preferably, the voltage created from the first to the second electrical output or the opposite way around is between 1-12 volt, such 2-11 volt, such as 3-10 volt, such as 4-9 volt, such as 5-8 volt, such as 6-7 volt. Thus, the electricity generating device may deliver power to light emitting means being connected between the first and second electrical output. Furthermore, an electric circuit comprising rectifier(s) and stabiliser(s) may be connected to the first and second electrical output so as to provide a constant direct current.

The light emitting means may comprise a lamp, such as a bicycle lamp, e.g., a light-emitting diode lamp (LED).

Additionally, a bicycle computer may be connected to the first and second electrical output, and which may provide the bicycle driver with information about, e.g., speed, travel distance, average speed, etc. In particular, the speed may be calculated on the time elapsing between two consecutive passages of a metallic element past a first or second magnet and on the diameter of the wheel. The computer may be either wireless or via a wire connected to the electrical outputs.

For improving the conduction of the magnetism from the first magnet(s) to the coil, the device may further comprise one or more backings mounted to the core of the coil and which conduct the magnetism from the first magnet(s) to the core for magnetising the core. The first magnet(s) may be provided between the backings and the coil. The backings may comprise metal plates.

For obtaining as many pole changes and thus as many changes in the magnetic flux as possible, the first and/or second magnet(s) may comprise more than two poles such as four or six or eight poles, and two, three, four or more coils may be provided.

The electricity generating device may comprise any feature and characteristic and combinations thereof described in relation to the two aspects disclosed in the present document.

Detailed description of the invention

A preferred embodiment of the invention will now be described in detail with reference to the drawings in which:

Fig. 1 shows a bicycle with an electricity generating device according to the invention mounted thereon,

Figs. 2-10 show different embodiments of the electricity generating device according to the invention, and

Figs.11a-c show a number of different embodiments of the metallic elements.

Fig. 1 shows a preferred embodiment of the invention mounted on a bicycle. A metallic element 1 is attached to the wheels of the bicycle e.g. the spokes or the centre of the bicycle, rotating with the wheel as the bicycle moves forward or backwards. One or more magnets 2 are attached to the frame of the bicycle along with one or more coils 3 producing electric signals or electricity.

The coils producing electricity may be connected to an electric circuit, converting any form of signals there may be produced by the induction in the coil, to a constant or other formed electric signal.

Fig. 2 shows one magnet 2 that can be rotated in relation to a coil 3 though they are both attached to the same part of the vehicle. The magnet 2 is positioned so that it may change the magnetic flux in the core 4 of the coil 3 as it is rotated. The metallic element 1 is attached to the second part of the vehicle so that it passes nearby the magnet 2 as the vehicle is moved. The extension of the core 4 is an extra feature that helps to make the magnet 2 to have a preferred position that the passing element 1 may disturb so that the magnet is turned 45°, 90°, 180° or 360° every time the metallic element 1 passes the magnet 2.

In another embodiment than the preferred, the magnet is oscillating and/or rotating back and forth less than 180°.

Both ways the magnetic flux through the coil is changed every time the metallic element 1 passes the magnet.

The passing metallic element 1 may disturb the position of the magnet 2 by changing the magnetic energy in the system consisting of the coil 3, the core 4 of the coil and the magnet 2. If the passing metallic element passes in such a way that the magnetic energy in the system is reduced for a period, due to the influence of the passing metallic element, the magnet will tend to follow this path until the lowest energy level is obtained during the pass. If the system is designed the right way, it will be possible to make the magnet follow the metallic element for a period, and as the metallic element 1 looses the magnetic contact with the magnet, the magnet 2 will not rotate back to the original position but rather continue to rotate until the basic position is attained again though this time with the magnetic poles switched so that the magnetic flux through the core of the coil has switched direction.

The core 4 of the coil may be made of soft magnetic material or be an alloy that can be permanent magnetised.

Fig. 3 shows another embodiment of the invention wherein the change of magnetic flux through the core of the coil is provided by allowing the magnet to oscillate – moving linear. As a metallic element 1 - preferable made of magnetic soft material - passes the magnet 2, the core 4 of the coil and the coil 3 is attracted towards the metallic element. This can happen if the magnet experiences that the magnetic energy in the system, consisting of the core of the coil, the magnet and the metallic element is reduced as the metallic element attains the shown position. The way the core 4 of the coil is designed determines the different magnetic energy levels that the system has before and during the pass of the metallic element 1. The system can be designed so that the magnet has – magnetically seen – two or more preferred positions. One position that is attained when the metallic element 1 is not nearby, and another one when the metallic element is positioned as shown in Fig. 3. If the core of the coil is designed the right way, this makes it possible for the magnetic flux in the coil to change size and direction as the metallic element 1 passes because the magnet oscillates.

Another embodiment of the invention is shown in Fig. 4 where two or more magnets are used to create the change of magnetic flux through the core of the coil. One or more magnets 2 - primary magnets - are positioned nearby the coil 3 and the core 4 of the coil, which may have material outside the coil as indicated on the illustration. These primary magnets may have a ferromagnetic backing 5, which helps to enlarge the magnetic influence from the magnet. Another or more magnets 2a – secondary magnets - are positioned so that they may be attracted to a passing magnetic element 1. The passing element is attached to the second part of the two parts of the bicycle e.g. the wheel of the bicycle.

Because both magnets are attached to a common rotatable element 6, attached to the first part of the two parts of the bicycle, the secondary magnets 2a may rotate the element 6 when attracted to the passing metallic element 1. When element 6 is rotated around the point 7 the primary magnets 2 change their position in relation to the core of the coil so that the magnetic flux through the core 4 and the coil 3 is changed. The system may return to a zero position as the metallic element 1 has passed.

The shown position of element 6 may be the preferred basic position.

Another embodiment of the invention is illustrated in Fig. 5 where a magnet 2 is oscillating between a coil 3 and a passing element 1. The difference between this embodiment and the one shown in Fig. 3 is that in the embodiment in Fig. 5 the flux through the core of the coil 3 never change it's direction (poles). The magnet is attracted to the metallic element that is preferably soft magnetic when this element passes.

As another embodiment the passing element 1 may be made of another not magnetic conductive material such as copper so that a magnetic skin effect is created as the element passes the magnet. Thus, a reduction of the magnetic strength in the magnet 2 is reduced. In such an embodiment it is not necessary to make the magnet oscillate because the variation in magnetic field is created as the skin effect of the metallic element eliminates or partly eliminates the magnetic force of the magnet 2 on the core of the coil 3.

In another embodiment the magnet is a part or constitutes the whole core of the coil 3, so that windings on the coil may overlap with the magnet.

As shown in Fig. 6 the passing metallic element 1 may be used in the same way as explained in the embodiment in Fig. 5, but different because the metallic element 1 may function as a magnetic 'bridge' between the core 4 of the coil 3 and the magnet 2. As the metallic element 1 - preferable magnetic soft - passes the coil 3, the metallic element 1 reduces the distance between the magnet 2 and the core of the coil in one end. Thus, the magnetic flux through the core of the coil is enforced compared to the situation where element 1 is not present. As the metallic element 1 moves further it will 'connect' the other end of the core 4 of the coil. In this situation the magnetic flux through the core of the coil 4 is diminished or even changed in direction.

If the metallic element 1 is not ferromagnetic the embodiment may work differently. In such an embodiment the metallic element may create a magnetic skin effect as it passes the magnet. Thus, the magnet looses its magnetic strength, and therefore the magnetic flux through the core of the coil is changed.

As shown in Fig. 7 another embodiment may consist of a rotating magnet 2, which is magnetised in different areas. As the metallic element 1 – preferable ferromagnetic – passes the magnet 2 the magnet 2 is rotated and the flux through the core 4 of the coil 3 is changed.

As shown in Fig. 8 another embodiment is illustrated. This embodiment function the same way as the one explained in Fig. 3, even though more magnets are used in the construction. Especially, the part of the magnet that is attracted to the metallic element 1 may have other dimensions or strength than other parts interacting with the core 4 of the coil 3. The metallic element 1 may be ferromagnetic and attract the magnet 2 or it may be non-ferromagnetic and then try to push the magnet away as it passes. The core comprises backings 5.

In another embodiment the magnet 2 may be an assembly of several magnets attached to each other oscillating back and forth.

As shown in Fig. 9 another embodiment may comprise a magnet 2, a coil 3 and a core to the coil 4. The metallic element 1 may pass between the magnet 2 and the coil and influence the magnetisation of the coil by either 'blocking' for the magnet's force by shortcutting the magnet as it passes, or enhancing the magnetisation of the core of the

coil by reducing the size of the air gap and by that enhancing the magnetic flux through the core 4 of the coil 3.

As shown in Fig. 10 another embodiment may comprise a rotatable magnet 2 being the core of the coil 3. As the metallic element 1 passes nearby the magnet 2 it will either try pushing the magnet away or attracting the magnet making the magnet rotate with or against the movement of the metallic element 1. Thus, the magnet turns 180° each time the metallic element passes and is then changing the direction of the magnetic field inside the coil. The magnet may have more than 2 poles.

Another embodiment of this variant may comprise the magnet inside the coil, and the metallic element may pass on the outside nearby the magnet that increases the magnetic flux through the magnet 2.

Alternatively, the metallic element may be ferromagnetic and have another shape e.g. U-formed with each leg of the U on each side of the magnet that increases the magnetic flux through the magnet 2 as it passes. The magnet 2 then does not have to be able to rotate.

As shown in Figs. 11a-c, the metallic element may have different shapes or forms. One preferred embodiment of the metallic element is a ring 9 with cuts or holes 10. The ring may be attached to the spokes in the wheel or may be attached to the centre of the wheel and thus rotating with the wheel. A ring formed metallic element is illustrated in Fig.11a and Fig. 11c.

This preferred embodiment may be integrated with other parts of the bicycle e.g. the disc in a disc brake.

Another embodiment of the metallic element is that the metallic element is the spokes of the wheel.

Another embodiment of the metallic element is the metallic element 11 shown in Fig. 11b that is e.g. attached to spokes of the wheel or any other part of the wheel. There might be several of these metallic elements attached at the same time in the same wheel.

CLAIMS

1. An electricity generating device for a vehicle comprising at least a first and a second part being moveable in relation to each other, the electricity generating device comprising:

- at least one coil attached to said first part, the coil having a core, layers of windings and a first and a second electrical output,
- one or more first magnets attached to said first part for creating a magnetic flux through the coil,
- one or more metallic elements attached to said second part, and

wherein a current is induced in the coil when the size of the magnetic flux passing through the coil is changed by moving the second part in relation to the first part, or vice versa, so that the metallic elements pass said first magnet(s).

2. An electricity generating device according to claim 1, wherein the first magnet(s) are fixed mounted in relation to the coil.

3. An electricity generating device according to claim 1, wherein the first magnet(s) oscillate in relation to the coil when the metallic elements pass.

4. An electricity generating device according to claim 1, wherein the first magnet(s) rotate in relation to the coil when the metallic elements pass.

5. An electricity generating device according to any of claims 1-4, wherein the first magnet(s) are positioned inside the coil so as to constitute the core of the coil.

6. An electricity generating device according to any of the preceding claims, wherein the metallic elements are adapted to neutralise the influence of the first magnet(s) on the coil by generating a magnetic field, which acts opposite in relation to the magnetic field created by the first magnet(s), due to eddy currents created during magnetisation of the metallic elements, the opposite magnetic field acting directly on the coil or first magnet(s).

7. An electricity generating device according to any of the preceding claims, wherein the metallic elements increase the magnetisation of the coil when passing by the first

magnet(s) and the coil, as the elements decrease the air gap through which the magnetism travels between the first magnet(s) and the coil.

8. An electricity generating device according to any of the claims 1 or 3-7, wherein the first magnet(s) are freely suspended in the coil so that each magnet can rotate around an axis of rotation being substantially perpendicular to the longitudinal axis of the coil.

9. An electricity generating device according to any of the preceding claims, wherein the metallic elements are adapted to prevent or at least damp the magnetisation of the coil by passing between the first magnet(s) and the coil for creating a magnetic skin effect.

10. An electricity generating device for a vehicle comprising at least a first and a second part being moveable in relation to each other, the electricity generating device comprising:

- at least one coil attached to said first part and comprising a core, layers of windings and a first and a second electrical output,
- one or more first magnets attached to said first part for creating a magnetic flux through the coil,
- one or more second magnets connected to the first magnet(s) for moving said first magnet(s),
- one or more metallic elements attached to said second part,

wherein a current is induced in the coil when the size of the magnetic flux passing through the coil is changed by moving the second part in relation to the first part, or vice versa, so that the metallic elements pass the second magnet(s).

11. An electricity generating device according to any of the preceding claims, wherein the metallic elements are made of magnetic conductive material (ferromagnetic material).

12. An electricity generating device according to any of the preceding claims, wherein the electricity generating device comprises mounting means for mounting it to a bicycle or car.

13. An electricity generating device according to any of the preceding claims, wherein the metallic elements are attached to the spokes of a wheel or rim or centre of a wheel on the vehicle.

14. An electricity generating device according to any of the preceding claims, wherein the metallic elements are formed as a ring with different formed cuts and protrusions or formed as a number of small metallic elements, such as discs.

15. An electricity generating device according to any of the preceding claims, wherein the metallic elements are constituted by the spokes of a wheel on the vehicle.

16. An electricity generating device according to any of the preceding claims, wherein the first part is the front fork of a bicycle and the second part is the wheel or spokes of the wheel on the bicycle, or vice versa.

17. An electricity generating device according to any of the preceding claims, wherein the number of windings in each layer of the coil exceed the number of layers of windings.

18. An electricity generating device according to claim 17, wherein the ratio between the number of windings in each layer and the number of layers is 2 or 3 or 4 or 5 or more.

19. An electricity generating device according to any of the preceding claims, further comprising one or more backings mounted to the core of the coil so as to conduct the magnetism from the first magnet(s) to the core for magnetising the core.

20. An electricity generating device according to claim 19, wherein the one or more first magnet(s) are positioned between the backings and the coil.

21. An electricity generating device according to any of the preceding claims, wherein the voltage from the first to the second electrical output or the opposite way around is between 1-12 volt, such 2-11 volt, such as 3-10 volt, such as 4-9 volt, such as 5-8 volt, such as 6-7 volt.

22. An electricity generating device according to any of the preceding claims, wherein the first and/or second magnet(s) comprise more than two poles such as four or six or eight poles.

23. An electricity generating device according to any of the preceding claims, wherein the device is mounted on a bicycle, e.g., near the hub on the front or rear wheel.

24. An electricity generating device according to any of the preceding claims, further comprising light emitting means connected between the first and second electrical output and/or an electric circuit comprising rectifier(s) and stabiliser(s) connected to the first and second electrical output so as to provide a constant direct current.

25. An electricity generating device according to claim 24, wherein the light emitting means comprise a lamp, such as a bicycle lamp, e.g., a light-emitting diode lamp (LED).

26. An electricity generating device according to any of the preceding claims, and comprising two, three, four or more coils.

27. An electricity generating device according to any of the preceding claims, wherein a bicycle computer is connected to the first and second electrical output, and which provides the driver with information about, e.g., speed, travel distance, average speed, etc.

28. An electricity generating device according to claim 27, wherein the computer is wireless or via a wire connected to the electrical outputs.

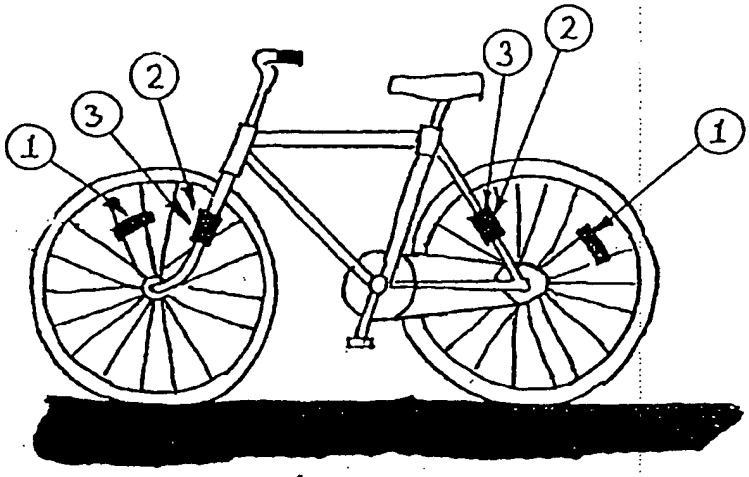

Fig. 1

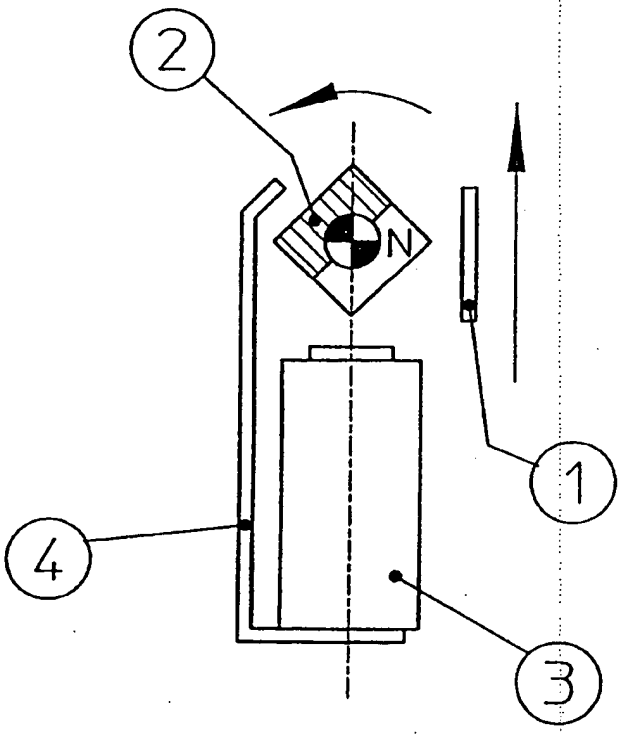

Fig. 2

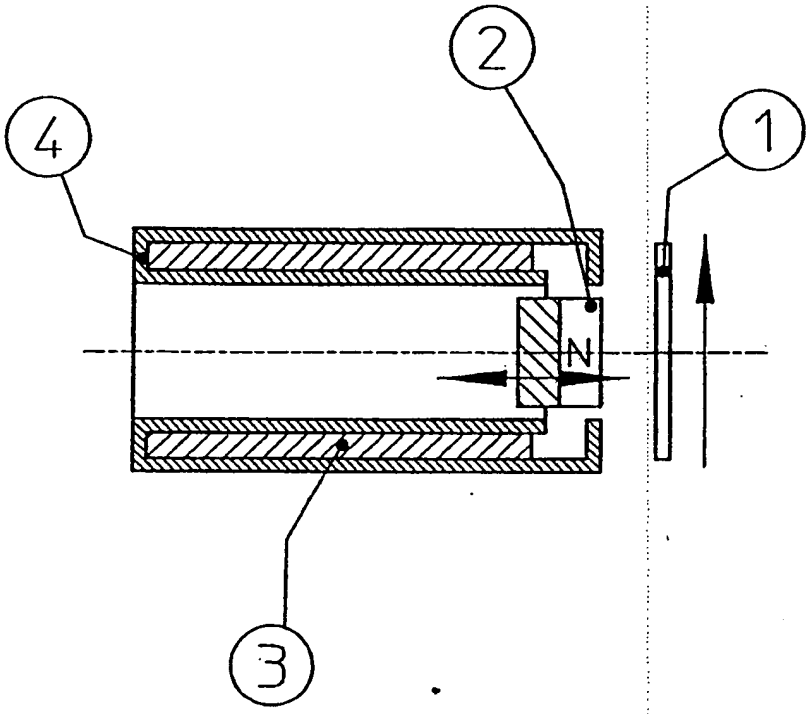

Fig. 3

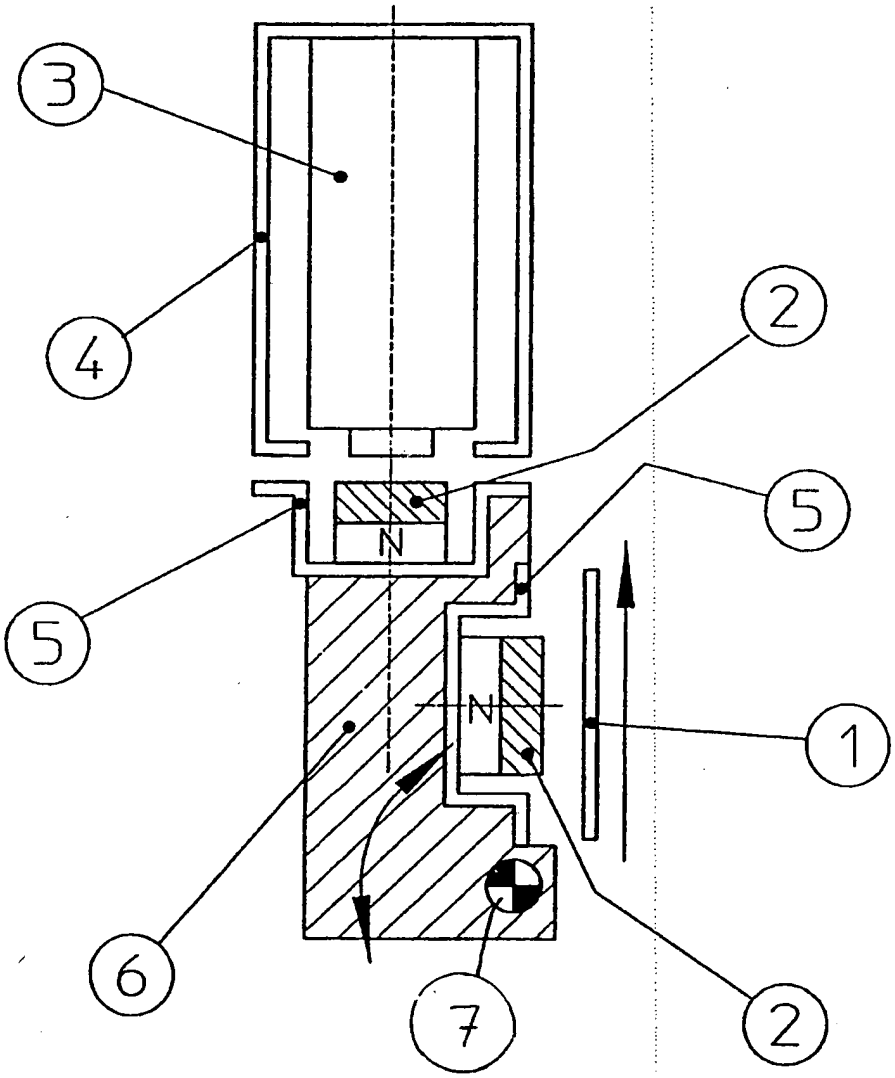

Fig. 4

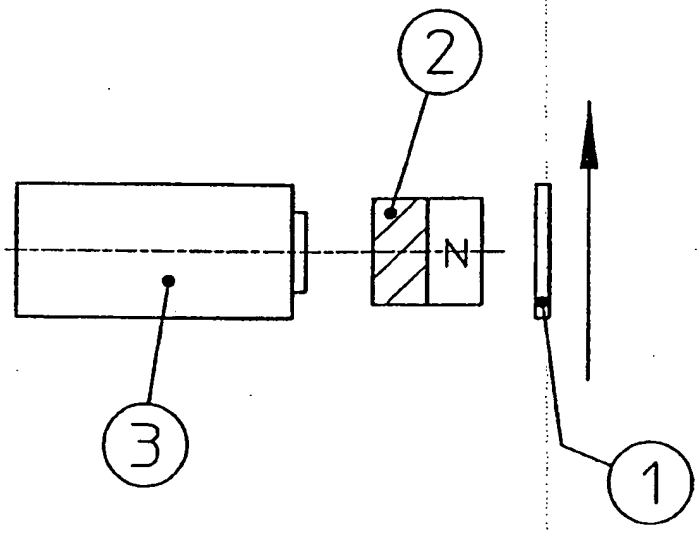

Fig. 5

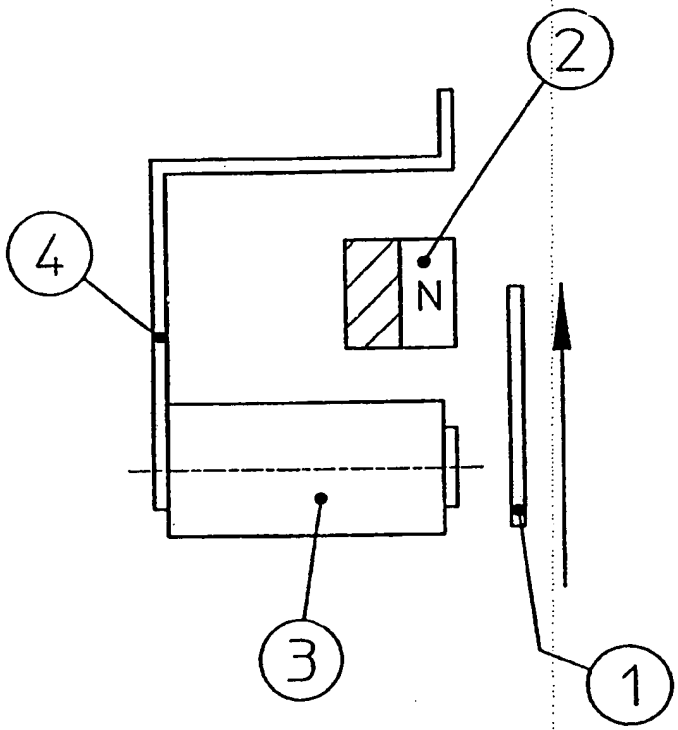

Fig. 6

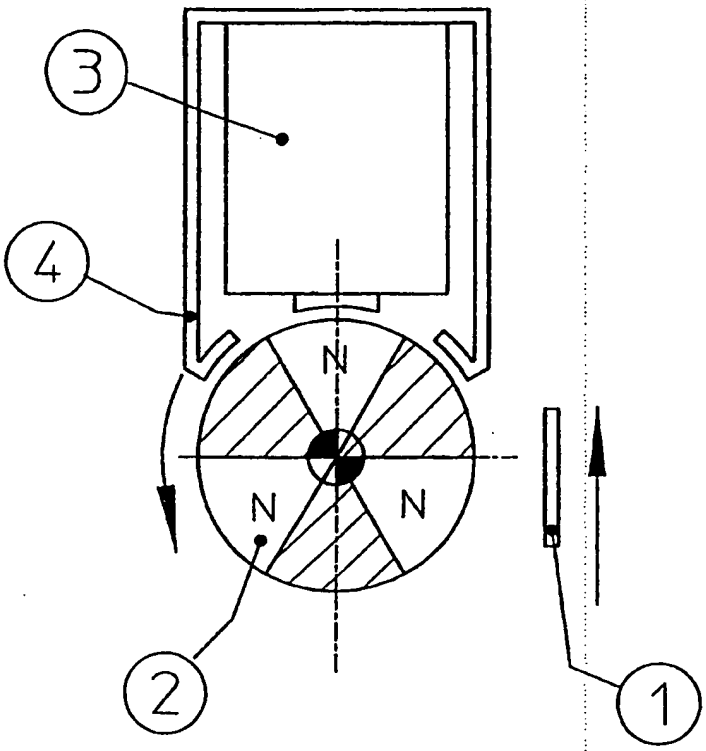

Fig. 7

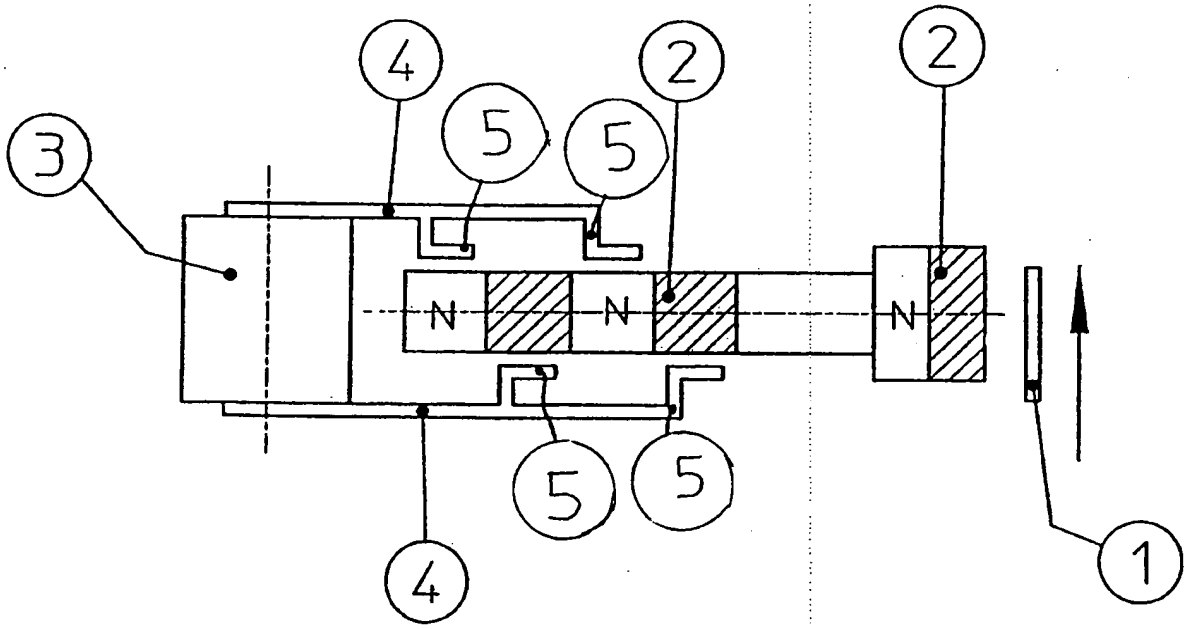

Fig. 8

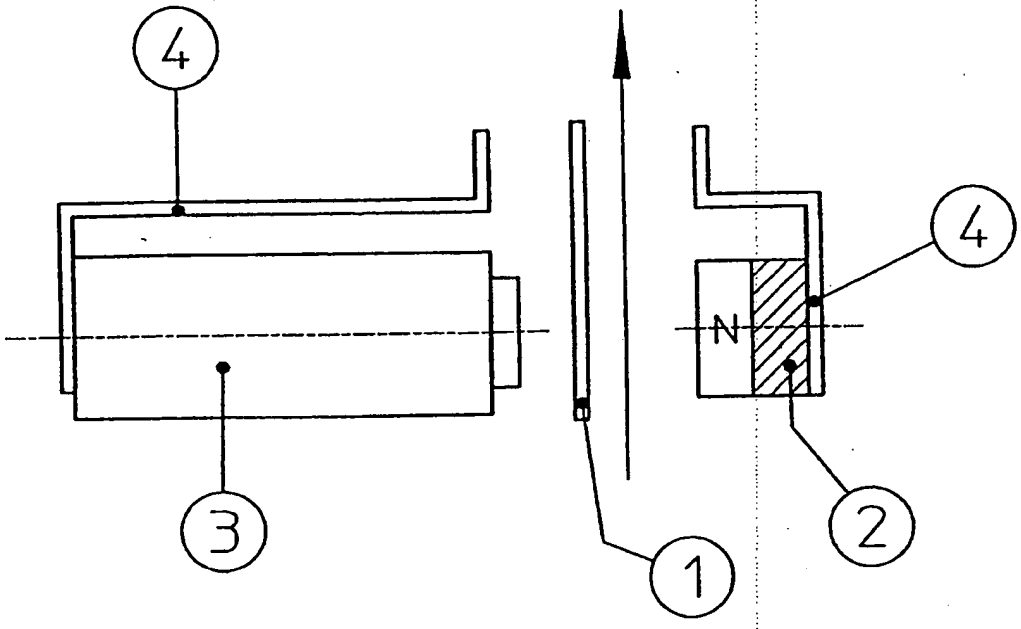

Fig. 9

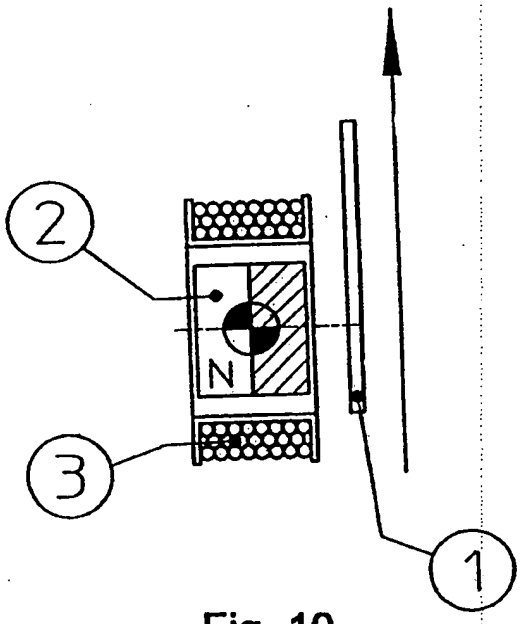

Fig. 10

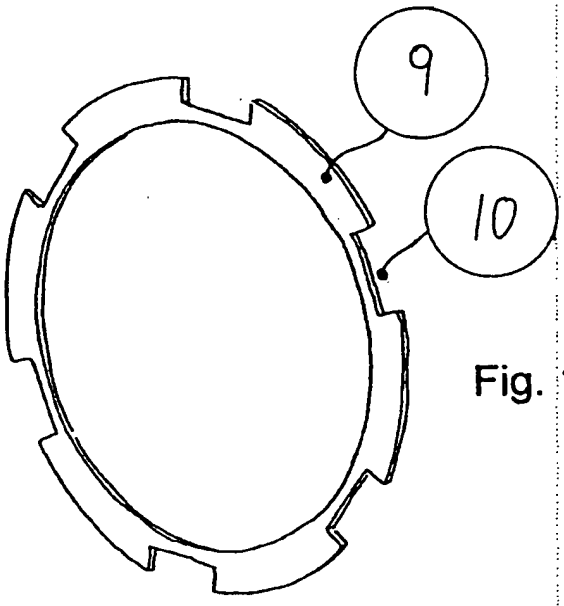

Fig. 11a

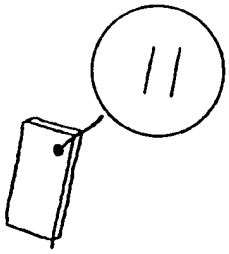

Fig. 11b

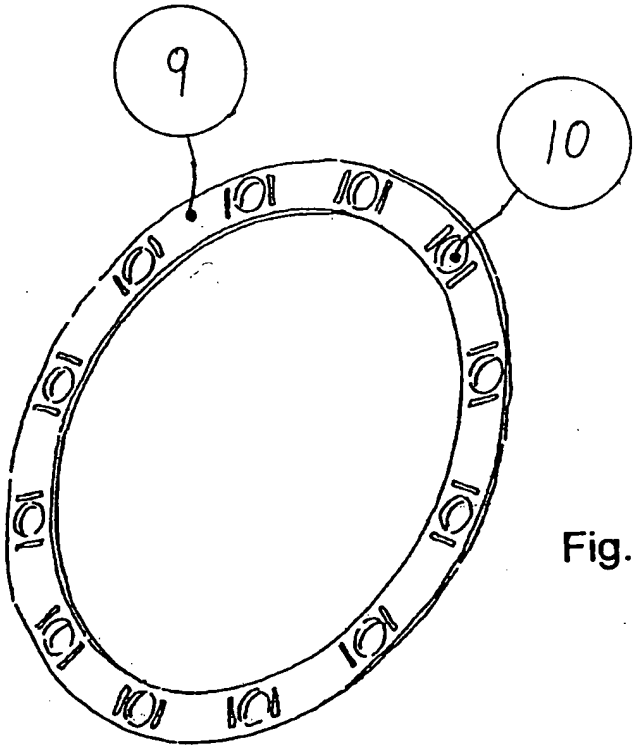

Fig. 11c

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/DK 00/00605

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H02K21/00 B62J6/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H02K B62J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 11940 A (IIJIMA TETSUYUKI) 26 May 1994 (1994-05-26) abstract; figures 1,2	1,2,6,9
A		10

X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 04, 30 April 1999 (1999-04-30) & JP 11 018388 A (SEIKO EPSON CORP), 22 January 1999 (1999-01-22) abstract	1,2

X	DE 25 08 940 A (NOTTER NIKOLAUS) 9 September 1976 (1976-09-09) page 1, line 33 -page 3, line 6	1,2,5,7
A		10-28

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 January 2001	11 04 2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bertil Nordenberg

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INTERNATIONAL SEARCH REPORT

Inte. onal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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